

TOSS-UP

1. ASTRONOMY: Multiple Choice: What astronomical phenomenon did Rudolph Wolf count by adding 10 times the number of groups of them he saw to the number of single ones he saw?

- W) supernovae
- X) asteroids
- Y) meteor showers
- Z) sunspots

ANSWER: **Z) sunspots** (Wolf sunspot number)

BONUS

1. ASTRONOMY: Multiple Choice: The periodic nature of eclipses is governed by a cycle called the "saros" cycle that, to the nearest year, lasts how long?

- W) 7 years
- X) 11 years
- Y) 18 years
- Z) 26 years

ANSWER: **Y) 18** years (11 days, 8 hours)

TOSS-UP

2. BIOLOGY: Short Answer: He proved that fermentation does not require oxygen and that the idea of spontaneous generation is not true. Name this French scientist that may be most famous for his idea that boiling liquid kills bacteria.

ANSWER: Louis **Pasteur**

BONUS

2. BIOLOGY: Short Answer: As a child, he learned to dive to the bottom of a lake. As an adult, he won two Academy Awards for his documentaries about oceanography. Name this French scientist who co-invented the first scuba-diving equipment and used it while diving off his ship *Calypso*.

ANSWER: Jacques-Yves **Cousteau** [coo-STOW]

TOSS-UP

3. MATH: Short Answer: What nickname often used for the "Gaussian" [GOW-see-un] or "normal" distribution comes from how it looks when graphed?

ANSWER: bell-shaped curve

BONUS

3. MATH: Short Answer: The equation $y = x^3 + 3x^2$ has a point of inflection or "saddle point" where x is equal to what value?

ANSWER: -1 (use 2nd derivative $6x + 6 = 0$)

TOSS-UP

4. PHYSICS: Short Answer: Russian students celebrate his birthday every May 7th by putting on an opera that tells of his possible career choices in ancient Greece besides physics. What physicist is quoted as saying, "Give me a lever and a place to stand, and I will move the world"?

ANSWER: Archimedes [ar-ka-MEE-deez]

BONUS

4. PHYSICS: Short Answer: For particles, it's the product of the mass and the square of the distance from the axis of rotation. Name this ratio of torque to angular acceleration, usually represented by a capital I.

ANSWER: moment of inertia

TOSS-UP

5. GENERAL SCIENCE: Multiple Choice: Compound, electron, scanning electron and transmission electron are all types of:

- W) telescopes
- X) microscopes
- Y) beakers
- Z) centrifuges

ANSWER: **X) microscopes**

BONUS

5. GENERAL SCIENCE: Multiple Choice: What scientist famous for his theory of "punctuated equilibrium" and best-selling books was nicknamed "the Carl Sagan [SAY-gun] of biology"?

- W) Stephen Hawking
- X) Kary Mullis
- Y) Richard Feynman
- Z) Stephen Jay Gould

ANSWER: **Z) Stephen Jay Gould**

TOSS-UP

6. CHEMISTRY: Multiple Choice: Which of these scientists does NOT have a chemical element named for him?

- W) Albert Einstein
- X) J. Robert Oppenheimer
- Y) Niels Bohr
- Z) Enrico Fermi

ANSWER: **X) J. Robert Oppenheimer**

BONUS

6. CHEMISTRY: Short Answer: Its name comes from the Latin word for "ant" because it was first made in 1670 from distilled ants. Name this acid with formula CHOOH.

ANSWER: **formic acid**

TOSS-UP

7. EARTH SCIENCE: Multiple Choice: The warm humid wind that blows from Africa onto the northern Mediterranean and brings rain to southern Europe is known as the:

- W) chinook
- X) monsoon
- Y) sirocco
- Z) tundra

ANSWER: Y) sirocco

BONUS

7. EARTH SCIENCE: Short Answer: It is roughly bounded by Alaska, the west coast of the Americas, Japan, and Antarctica. Give the three-word term for this area of the Pacific Ocean that contains more than half of the world's active volcanoes.

ANSWER: Ring of Fire

TOSS-UP

8. MATH: Short Answer: Calculate the value of x if the three angles of a triangle are $(3x + 3)^\circ$, $(x - 6)^\circ$ and $(2x - 3)^\circ$.

ANSWER: 31 ($6x - 6 = 180$)

BONUS

8. MATH: Short Answer: Calculate the volume of a sphere with radius 6 inches, using "pi" in your answer if necessary.

ANSWER: 288 π cubic inches ($\frac{4}{3} \times 6 \times 6 \times 6 \times \pi$)

TOSS-UP

9. BIOLOGY: Short Answer: In the world of biology, GM does not mean "General Motors", but rather what two-word description of crops specifically designed to withstand disease?

ANSWER: Genetically Modified

BONUS

9. BIOLOGY: Multiple Choice: The spineless cactus and the Shasta daisy were just two of the hybrid plants created by:

- W) Booker T. Washington
- X) George Washington Carver
- Y) Luther Burbank
- Z) Gregor Mendel

ANSWER: Y) Luther Burbank

TOSS-UP

10. CURRENT EVENTS: Short Answer: Minnesota researchers announced in 2004 a new way to extract it from ethanol by using two metals used in a car's catalytic converters. Name this most abundant element in the universe.

ANSWER: hydrogen

BONUS

10. CURRENT EVENTS: Short Answer: In March 2004, the Canadian government admitted that during World War II, it conducted secret chemical experiments on more than 3,000 of its own soldiers, primarily involving what chlorine-and-sulfur compound, named for its yellow color?

ANSWER: mustard gas

TOSS-UP

11. ASTRONOMY: Multiple Choice: The name of Pluto's only satellite is:

- W) Titan
- X) Charon [CARE-un]
- Y) Oberon
- Z) Phobos

ANSWER: **X) Charon**

BONUS

11. ASTRONOMY: Short Answer: The ancients called it "Phosphorus" when seen in the morning and "Hesperus" at night. Name this planet that is the brightest object in Earth's sky other than the sun and the moon.

ANSWER: **Venus**

TOSS-UP

12. GENERAL SCIENCE: Multiple Choice: The process of removing the salt from sea water before drinking it is called:

- W) desalinization [dee-sal-a-na-ZAY-shun]
- X) purification
- Y) condensation
- Z) ionization

ANSWER: **W) desalinization**

BONUS

12. GENERAL SCIENCE: Short Answer: It happens to things that undergo extreme changes in temperature and have their outer layer come off. Give this word also used to mean "the process of getting rid of the dead outer layer of skin on your body."

ANSWER: **exfoliation** [ex-fo-lee-A-shun] (accept forms of the word)

TOSS-UP

13. CHEMISTRY: Short Answer: Discovered by Harold Urey, it produces the "heavy water" used in the nuclear industry when combined with oxygen. Name this isotope of hydrogen that has a mass number of two because of its neutron.

ANSWER: deuterium [doo-TEER-ee-um]

BONUS

13. CHEMISTRY: Short Answer: Four and a half times heavier than air, it is the most popular gas in strobe lamps and high-speed electronic flash bulbs. Name this "strange" element on the periodic table just below krypton and just above radon.

ANSWER: xenon

TOSS-UP

14. PHYSICS: Multiple Choice: Which of these units is used to measure inductance?

- W) millihenries
- X) picofarads
- Y) microns
- Z) kilometers

ANSWER: W) millihenries

BONUS

14. PHYSICS: Short Answer: What electrical parameter is commonly measured in farads [FAIR-adz]?

ANSWER: capacitance

TOSS-UP

15. MATH: Short Answer: For a complex number, it is the square root of the quantity (a squared plus b squared). Name this concept expressed with real numbers by putting a vertical line on each side.

ANSWER: absolute value

BONUS

15. MATH: Short Answer: When you multiply the annual interest rate (in percent) on a savings account by the number of years at that rate until your money is doubled, the result is always very close to what two-digit number?

ANSWER: 72

TOSS-UP

16. BIOLOGY: Multiple Choice: Its name comes from the Greek for "digestion." Identify this sac inside a cell that recycles the cell's waste products.

- W) endoplasmic reticulum
- X) cell membrane
- Y) mitochondria
- Z) lysosome

ANSWER: Z) lysosome

BONUS

16. BIOLOGY: Short Answer: What process involves a single strand of DNA passing its information to a strand of messenger RNA, which the latter then uses for protein synthesis?

ANSWER: transcription

TOSS-UP

17. EARTH SCIENCE: Short Answer: Its two main types are "advection" (which occurs when two currents of air meet each other) and "radiation", when cold nights cause the land surface to quickly lose heat. Name this cloud that collects at the surface of the earth and makes it difficult to drive a car.

ANSWER: fog

BONUS

17. EARTH SCIENCE: Short Answer: They are caused by vertical movements of the sea floor and not from the gravitational force that affects the tides. Give the Japanese term for these waves sometimes called "tidal waves" in English.

ANSWER: tsunami (tsoo-NAW-mee)

TOSS-UP

18. GENERAL SCIENCE: Multiple Choice: The process of saponification [sa-PON-a-fa-CAY-shun] is used most often when making what common consumer product?

- W) nylon
- X) gasoline
- Y) printer ink
- Z) soap

ANSWER: Z) soap

BONUS

18. GENERAL SCIENCE: Short Answer: Transistors in this state can't handle any more current. What term also describes a hydrocarbon without double or triple bonds but with as many single hydrogen bonds as possible?

ANSWER: saturated or saturation

TOSS-UP

19. CHEMISTRY: Multiple Choice: How many carbon atoms are in a molecule of propane?

- W) 2
- X) 3
- Y) 4
- Z) 5

ANSWER: **X) 3** (C_3H_8)

BONUS

19. CHEMISTRY: Short Answer: One of their major characteristics is a delocalized pi orbital. They are used both as chemical solvents and as explosives, like TNT. Name this type of hydrocarbon whose simplest example is benzene.

ANSWER: **aromatic** hydrocarbon

TOSS-UP

20. MATH: Multiple Choice: The y-intercept value of the line $3x = 5y + 30$ is equal to:

- W) 10
- X) 6
- Y) -6
- Z) -10

ANSWER: **Y) -6** ($y = 3/5 x - 6$)

BONUS

20. MATH: Multiple Choice: Mike was 22 years old when his son Steve was born. If the sum of their two ages now is 50, then Steve is now:

- W) 14 years old
- X) 22 years old
- Y) 28 years old
- Z) 36 years old

ANSWER: **W) 14 years old** ($2x + 22 = 50$; Mike is 36)

TOSS-UP

21. CURRENT EVENTS: Short Answer: The stock of Krispy Kreme Donuts dropped 30% on one day in 2004 after the company attributed lower profits to the large number of Americans who have stopped eating donuts as part of what popular type of diet?

ANSWER: low-carbohydrate (or Atkins) diet

BONUS

21. CURRENT EVENTS: Multiple Choice: A decade after it became the last state in America to get a WalMart, what state was put on a list of endangered places in 2004 because activists feel that too many WalMarts there have spoiled the views of its famed "green mountains"?

- W) Montana
- X) Vermont
- Y) Alaska
- Z) Wyoming

ANSWER: X) Vermont (the "Green Mountain State")

TOSS-UP

22. MATH: Short Answer: According to the Pythagorean Identity, what do the sine squared of x and the cosine squared of x always add up to?

ANSWER: 1

BONUS

22. MATH: Short Answer: Two of them can have a product of zero even if neither one is actually equal to zero. Give this term introduced by Arthur Cayley to describe a square or rectangular array of numbers.

ANSWER: matrix

TOSS-UP

23. BIOLOGY: Multiple Choice: If your usual body temperature is more than one degree below the standard 98.6, you may have lower-than-average levels of the hormones secreted by the:

- W) pituitary
- X) hypothalamus
- Y) pineal gland
- Z) thyroid

ANSWER: Z) thyroid

BONUS

23. BIOLOGY: Short Answer: It wasn't discovered until 1977 but is now known as one of the top causes of epidemic pneumonia. What disease is named for the 34 people who died from it after attending a Philadelphia convention?

ANSWER: Legionnaire's Disease

TOSS-UP

24. PHYSICS: Multiple Choice: The letter generally used to indicate enthalpy is a capital:

- W) E
- X) H
- Y) I
- Z) R

ANSWER: X) H

BONUS

24. PHYSICS: Short Answer: What two-word term is used for the amount of heat required (in calories) to raise the temperature of one gram of a substance by one degree Celsius?

ANSWER: specific heat

TOSS-UP

25. CHEMISTRY: Multiple Choice: What type of atomic reaction takes place when a large molecule is "cracked" into smaller molecules?

- W) mitosis
- X) fusion
- Y) dilation
- Z) fission

ANSWER: **Z) fission**

BONUS

25. CHEMISTRY: Multiple Choice: What law of chemistry can be written with the equation $V_1 \text{ over } T_1 = V_2 \text{ over } T_2$?

- W) Boyle's Law
- X) Gay-Lussac's Law
- Y) Charles' Law
- Z) Avogadro's Law

ANSWER: **Y) Charles' Law**

END OF ROUND 1

TOSS-UP

1. ASTRONOMY: Short Answer: "Hypercronius" and "Georgian Star" were just two of the names proposed in 1781 to describe what object, along with the name "Herschel" in honor of its discoverer, astronomer Sir William Herschel?

ANSWER: the planet Uranus

BONUS

1. ASTRONOMY: Short Answer: Give the 2-word term for the area just outside a black hole that you cannot escape from, no matter how hard you try.

ANSWER: event horizon

TOSS-UP

2. BIOLOGY: Short Answer: One of its types is found in ribosomes, while another carries amino acids to the ribosomes. Single-stranded viruses with its label include the polio virus and various retroviruses. Name this material that uses uracil [YUR-a-sill] instead of thymine.

ANSWER: ribonucleic acid or RNA

BONUS

2. BIOLOGY: Short Answer: It takes place in the cell body and forms the backbone of cellular respiration. Name this process that turns glucose into pyruvate.

ANSWER: glycolysis [gly-CALL-a-sis]

TOSS-UP

3. MATH: Multiple Choice: The mathematical curve known as a “cardioid” [KAR-dee-oyd] is called that because it looks like what part of the human body?

- W) brain
- X) heart
- Y) ribcage
- Z) foot

ANSWER: X) heart

BONUS

3. MATH: Short Answer: Calculate the dot product of Vector A and Vector B if Vector A is $(2\mathbf{i} + 3\mathbf{j} + 4\mathbf{k})$ and Vector B is $(3\mathbf{i} - 2\mathbf{j} + 2\mathbf{k})$.

ANSWER: 8 $(6 - 6 + 8)$

TOSS-UP

4. PHYSICS: Multiple Choice: Counting the zeroth law, how many laws of thermodynamics are there?

- W) 3
- X) 4
- Y) 5
- Z) 6

ANSWER: X) 4

BONUS

4. PHYSICS: Short Answer: Many types of sunglasses reduce glare by filtering out all light that does not vibrate at a certain angle. Give the term for the type of material used to do this filtering.

ANSWER: polarizer (accept forms of the word)

TOSS-UP

5. GENERAL SCIENCE: Multiple Choice: What condition that usually accompanies an injury can be treated with first aid by remembering the phrase, "If the face is red, you raise the head; if the face is pale, you raise the tail" ?

- W) heatstroke
- X) shock
- Y) sunburn
- Z) rigor mortis

ANSWER: X) shock

BONUS

5. GENERAL SCIENCE: Short Answer: During 2003, the FDA announced manufacturers must now acknowledge how much of it their products contain. Name this substance, found in most snack foods, that may contribute to heart disease.

ANSWER: trans fatty acids

TOSS-UP

6. CHEMISTRY: Short Answer: It has been used to enhance the red color of wine and is still used as an active ingredient in many laxatives. Name this substance used in chemistry lab because it remains colorless in an acid solution but turns dark red in a base.

ANSWER: phenolphthalein (fa-NOLF-tha-leen or fee-nul-THAY-leen)

BONUS

6. CHEMISTRY: Multiple Choice: What chemical term describes a hydrocarbon compound that has an attached OH group?

- W) ketone
- X) alkane
- Y) ester
- Z) alcohol

ANSWER: alcohol

TOSS-UP

7. EARTH SCIENCE: Short Answer: The Gutenberg discontinuity separates it from the core, while the Moho discontinuity separates it from the crust. Identify this intermediate layer of the earth.

ANSWER: mantle

BONUS

7. EARTH SCIENCE: Short Answer: Its discovery allowed Japan to send gas-filled balloon bombs to the northwestern United States during World War II. Name this narrow band of very fast wind in the upper troposphere, used by high-flying aircraft to speed their journey.

ANSWER: jet stream

TOSS-UP

8. MATH: Short Answer: Draw two horizontal parallel lines AC and DF (with A and D on the left), and a transversal line GH crossing them both (with G at the top). AC and GH intersect at point B, while DF and GH intersect at point E. In this diagram, what is the relationship between the congruent angles ABG and CBE?

ANSWER: vertical angles

BONUS

8. MATH: Multiple Choice: In the same diagram, the angles GBC and DEH are

- W) alternate exterior angles
- X) alternate interior angles
- Y) corresponding angles
- Z) supplementary angles

ANSWER: W) alternate exterior angles

TOSS-UP

9. BIOLOGY: Short Answer: Found mainly in California, one of its specimens is more than 3,500 years old. Name this type of tree with one species called the “redwood” that shares its name with a 19th-century Cherokee Indian.

ANSWER: sequoia

BONUS

9. BIOLOGY: Short Answer: All adult members of this group have a pentaradial body organization. What phylum of animals has five main classes that include sea lilies, sand dollars, sea cucumbers, and two types of starfish?

ANSWER: echinoderms or Echinodermata

TOSS-UP

10. CURRENT EVENTS: Multiple Choice: The Chinese city of Guangzhou [gwong-ZHO] tried to do their part to prevent SARS in 2004 by killing thousands of local civets [SIV-utz] thought to spread the disease. What kind of animal is a civet?

- W) a snake
- X) a lizard
- Y) a cat
- Z) a rat

ANSWER: Y) a cat

BONUS

10. CURRENT EVENTS: Short Answer: In March 2004, scientists announced the discovery of the most remote object known to orbit the sun. Identify this planetoid, named for the Inuit [IN-oo-ut] goddess who created the sea.

ANSWER: Sedna

TOSS-UP

11. ASTRONOMY: Multiple Choice: You would find the Sea of Nectar, Sea of Muscoy, Sea of Cold and Sea of Showers on:

- W) Venus
- X) the moon
- Y) Jupiter
- Z) Mercury

ANSWER: **X) the moon**

BONUS

11. ASTRONOMY: Short Answer: It is partly named for Johann Titius [TISH-us], who first noticed that the semi-major axes of the orbits of the known planets fit the equation $0.4 + (0.3)2^n$, where $n = 1$ describes the Earth. What scientist is this concept more popularly named for?

ANSWER: **Bode's Law**

TOSS-UP

12. GENERAL SCIENCE: Multiple Choice: The 100th anniversary of his birth was marked in 2003. Name this doctor famous for his 1946 book *Common Sense Book of Baby and Child Care*.

- W) Robert Atkins
- X) Phil McGraw
- Y) Benjamin Spock
- Z) William Sears

ANSWER: **Y) Benjamin Spock**

BONUS

18. GENERAL SCIENCE: Short Answer: It is made commercially from the whey used in creating cheese. Name this type of sugar contained in cow's milk that causes stomach trouble for humans who can't "tolerate" it.

ANSWER: **lactose**

TOSS-UP

13. CHEMISTRY: Multiple Choice: If a mole of water, H_2O , weighs 18 grams, what fraction of that weight is made up of the oxygen atoms?

- W) 8/9
- X) 7/8
- Y) 1/3
- Z) 1/9

ANSWER: **W) 8/9** (16/18)

BONUS

13. CHEMISTRY: Short Answer: Lactic acid fits this description because its two possible structures cannot be superimposed over each other. Name this concept that allows some organic compounds to be termed "left-handed" or "right-handed."

ANSWER: **chirality** [ky-RAL-a-tee]

TOSS-UP

14. PHYSICS: Multiple Choice: Calculate the equivalent resistance when a resistor of 10 ohms and another of 15 ohms are placed in parallel with each other.

- W) 6 ohms
- X) 25 ohms
- Y) 50 ohms
- Z) 150 ohms

ANSWER: **W) 6 ohms** ($[10 \times 15] / [10 + 15]$)

BONUS

14. PHYSICS: Short Answer: It calculates the value of an unknown resistor by changing one of its three known resistors. What instrument named for a British physicist features four resistors connected in the shape of a diamond?

ANSWER: **Wheatstone bridge**

TOSS-UP

15. MATH: Short Answer: What is the radius of the circle represented by the equation $x^2 + y^2 = 121$?

ANSWER: 11 units

BONUS

15. MATH: Short Answer: If $y = \cos 2x$, calculate the derivative of y with respect to x .

ANSWER: $-2 \sin 2x$

TOSS-UP

16. BIOLOGY: Short Answer: Recent studies show that one dose of doxycycline [dox-a-SIGH-klin] will kill this illness caused by *Borrelia burgdorferi* [bo-REE-lee-a burg-DORF-a-ree]. What disease, discovered in the northeastern United States, is carried by infected deer ticks?

ANSWER: Lyme disease

BONUS

16. BIOLOGY: Short Answer: Once marketed as a sedative even for children, it is now used to treat AIDS, cancer and leprosy. Name this drug that became infamous in the 1960's after it was linked to birth defects in some 10,000 babies.

ANSWER: thalidomide [tha-LID-a-mide]

TOSS-UP

17. EARTH SCIENCE: Multiple Choice: What mineral that turns yellow with age is a form of calcium phosphate that can be obtained from the whale, the walrus and the elephant?

- W) gneiss
- X) marble
- Y) chalcedony
- Z) ivory

ANSWER: Z) ivory

BONUS

17. EARTH SCIENCE: Multiple Choice: Name the blood-red mineral whose combination of mercury and sulfide makes it the only known ore of mercury.

- W) cinnabar
- X) sapphire
- Y) lapis lazuli
- Z) corundum

ANSWER: W) cinnabar

TOSS-UP

18. GENERAL SCIENCE: Short Answer: What scientific term describes any process carried out at a temperature below -183 degrees Celsius?

ANSWER: cryogenics

BONUS

12. GENERAL SCIENCE: Multiple Choice: Its Turkish species became so popular that it created a 17th century bull market in Holland. What flower, at one point, cost as much as a ship?

- W) rose
- X) poinsettia
- Y) magnolia
- Z) tulip

ANSWER: Z) tulip

TOSS-UP

19. CHEMISTRY: Short Answer: When filling atomic orbitals, which orbitals are filled after 4s but before 4p?

ANSWER: 3d (or 3d₁₀)

BONUS

19. CHEMISTRY: Multiple Choice: In 2003, chemical element number 110 was officially named for what German city where it was created from fusing together a lead-atom nucleus and a nickel-atom nucleus?

- W) Hamburg
- X) Munich
- Y) Darmstadt
- Z) Berlin

ANSWER: Y) Darmstadt [DARM-shtot]

TOSS-UP

20. MATH: Short Answer: Give the TWO values of x that satisfy the equation $x^2 + 2x - 8 = 0$.

ANSWER: 2 and -4

BONUS

20. MATH: Multiple Choice: You want to find an old girlfriend by searching her phone number on the Internet, but all you know is the last 2 digits of her 7-digit number. Even though the first digit of the seven can't be 0 or 1, you'll still have to search how many different combinations of the 5 missing digits?

- W) 8,000
- X) 10,000
- Y) 32,768
- Z) 80,000

ANSWER: Z) 80,000 ($8 \times 10 \times 10 \times 10 \times 10$)

TOSS-UP

21. CURRENT EVENTS: Short Answer: Produced when sunlight hits water, it was discovered in February 2004 to exist in the atmosphere of Mars. Name this chemical compound with formula H_2O_2 .

ANSWER: hydrogen peroxide

BONUS

21. CURRENT EVENTS: Multiple Choice: One recent researcher claims Alexander the Great did not die of typhoid, but rather of what recently-notorious virus, marked in Alexander's day by a group of crows that suddenly fell dead in front of him?

- W) West Nile virus
- X) SARS
- Y) AIDS
- Z) the Ebola virus

ANSWER: W) West Nile virus

TOSS-UP

22. MATH: Short Answer: Weapons should be shot at this angle to fly the maximum horizontal distance from their origin. Identify this angle whose sine in the first quadrant is equal to its cosine.

ANSWER: 45°

BONUS

22. MATH: Short Answer: A kilobyte of computer memory is not exactly 1,000 bytes, but 2^{10} bytes. 32 kilobytes is actually 2^{15} bytes, which is how many?

ANSWER: 32,768

TOSS-UP

23. BIOLOGY: Multiple Choice: What biome contains a deep layer of soil that never thaws in the summer called "permafrost"?

- W) chaparral
- X) tundra
- Y) taiga
- Z) rain forest

ANSWER: X) tundra

BONUS

23. BIOLOGY: Multiple Choice: The protist kingdom is divided into two phyla: those organisms similar to animals (called "protozoa"), and those similar to plants, which are called:

- W) protists
- X) fungi
- Y) algae
- Z) mold

ANSWER: Y) algae

TOSS-UP

24. PHYSICS: Short Answer: What term represents the change of velocity with respect to time?

ANSWER: acceleration

BONUS

24. PHYSICS: Multiple Choice: What letter of the Greek alphabet generally denotes angular velocity?

- W) lambda
- X) mu
- Y) omega
- Z) beta

ANSWER: Y) omega (ω)

TOSS-UP

25. CHEMISTRY: Short Answer: Doctors use it to adjust dosages of medicine for their patients. In chemistry, it is often done by pouring one solution into another until either the solution or the litmus paper changes color. Name this technique, used to measure the amount of a substance that will completely react with a known reagent.

ANSWER: titration

BONUS

25. CHEMISTRY: Multiple Choice: The National Institute of Standards and Technology supervises America's national clock, now accurate to one second in twenty million years. What chemical element's atoms have helped define the length of one second since 1972?

- W) gallium
- X) strontium
- Y) neodymium
- Z) cesium [SEE-zee-um]

ANSWER: Z) cesium

END OF ROUND 2

TOSS-UP

1. ASTRONOMY: Multiple Choice: What ancient Greek spawned astronomy research from his famed Academy?

- W) Aristotle
- X) Aristarchus of Samos
- Y) Empedocles
- Z) Plato

ANSWER: Z) Plato

BONUS

1. ASTRONOMY: Short Answer: Give the title of Carl Sagan's 1970's 13-part PBS series on astronomy and the companion best-selling book.

ANSWER: Cosmos

TOSS-UP

2. BIOLOGY: Multiple Choice: In what phase of mitosis do the chromatids first separate from the spindle?

- W) anaphase
- X) telophase
- Y) metaphase
- Z) prophase

ANSWER: W) anaphase

BONUS

2. BIOLOGY: Short Answer: He discovered the final pathway by which food molecules are broken down into energy in living tissues. Identify this German-born chemist who has the cycle named for him.

ANSWER: Hans Krebs

TOSS-UP

3. MATH: Multiple Choice: Which of these containers holds the most volume?

- W) a 1500-cc graduated cylinder
- X) a two-liter bottle
- Y) a 46-ounce can
- Z) a half-gallon jug

ANSWER: **X) two-liter bottle** (67.6 oz; 1500 cc = 50.7 oz, half-gallon = 64 oz.)

BONUS

3. MATH: Short Answer: A true one requires 4 dimensions, but the 3-D ones still look pretty cool. Name this item made (theoretically) by sewing two Mobius strips together to create a one-sided figure with no boundary.

ANSWER: **Klein Bottle**

TOSS-UP

4. PHYSICS: Short Answer: One example of this idea is that flow speeds up in a nozzle when the pressure drops. What concept named for a Swiss scientist also explains how the pressure difference on the surfaces of an airplane wing causes the plane to lift off the ground?

ANSWER: **Bernoulli's** [bur-NOO-leez] Principle

BONUS

4. PHYSICS: Multiple Choice: In 1928, Max Born said, "Physics, as we know it, will be over in 6 months" after he heard that the electron had been perfectly described through equations derived by what physicist and mathematician?

- W) Werner Heisenberg
- X) Niels Bohr
- Y) Paul Dirac [DEER-ack]
- Z) Georg Riemann [REE-mawn]

ANSWER: **Y) Paul Dirac**

TOSS-UP

5. GENERAL SCIENCE: Multiple Choice: Its current standard appeared in 1995, 12 years after its first edition. Name this computer language first adopted by the federal government in 1983 and named for the daughter of Lord Byron.

- W) Algol
- X) Java
- Y) Lisa
- Z) Ada

ANSWER: Z) Ada

BONUS

5. GENERAL SCIENCE: Short Answer: The Polish gave their information on it to Britain just before Hitler began World War II. Within a year, the British had figured out most of its secrets in their headquarters at Bletchley Park. Give the name of this German machine whose dials allowed trillions of possible secret codes.

ANSWER: Enigma

TOSS-UP

6. CHEMISTRY: Short Answer: With a methyl group attached, it is called a "toluene" [TALL-u-een]. With an OH group attached, it is called a "phenol" [FEE-nall]. Name this carbon compound whose molecules are shaped like rings.

ANSWER: benzene

BONUS

6. CHEMISTRY: Short Answer: Its bichromate is used in tanning leather and turns the edges of treated leather a bluish-green color. What metallic element needed in the human diet can be found in foods like bananas?

ANSWER: potassium

TOSS-UP

7. EARTH SCIENCE: Multiple Choice: One way of learning the approximate age of an object is by using the known 5,730-year half-life of the 14 isotope of:

- W) nitrogen
- X) carbon
- Y) helium
- Z) sulfur

ANSWER: X) carbon

BONUS

7. EARTH SCIENCE: Multiple Choice: If you drop a crystalline mineral and it breaks into ugly pieces of trash, you are said to have "fractured" the rock. Give the term for when a rock cracks along its break patterns so as to be both pleasing to the eye and useful:

- W) cleavage
- X) separation
- Y) geode
- Z) breakage

ANSWER: W) cleavage

TOSS-UP

8. MATH: Short Answer: The number e is called e (instead of some other letter) because it was the first letter of the last name of--what legendary Swiss mathematician who discovered it?

ANSWER: Leonhard Euler [OY-ler]

BONUS

8. MATH: Short Answer: To write the fraction $1/3$ as a repeating decimal, write .3 and put a bar over the three to indicate that the three is repeating. What is the mathematical term for the bar that goes over the 3?

ANSWER: vinculum [VINK-ya-lum]

TOSS-UP

9. BIOLOGY: Short Answer: It is the most common genetic disorder in America and is named for the British scientist who published a paper on it in 1866. Name this disease once called "mongoloidism".

ANSWER: Down Syndrome

BONUS

9. BIOLOGY: Multiple Choice: People with Down Syndrome have an extra copy of which of the 23 human chromosomes?

- W) 6
- X) 12
- Y) 19
- Z) 21

ANSWER: Z) 21

TOSS-UP

10. CURRENT EVENTS: Multiple Choice: When NASA's Mars rover *Spirit* had problems in January 2004, which twin rover took over much of the work?

- W) *Discovery*
- X) *Opportunity*
- Y) *Challenger*
- Z) *Red Planet*

ANSWER: X) Opportunity

BONUS

10. CURRENT EVENTS: Short Answer: What country's top scientist, Abdul Qadeer Khan, announced in February 2004 that he had arranged to share nuclear technology with Iran, Libya and North Korea?

ANSWER: Pakistan

TOSS-UP

11. ASTRONOMY: Short Answer: Identify the American astronomer whose namesake 1929 law says that the size of the universe is constantly expanding.

ANSWER: Edwin Hubble

BONUS

11. ASTRONOMY: Short Answer: The astronomical symbol for the planet Pluto is a combination of the letters P and L, not only because they're the first 2 letters of "Pluto", but because they are the initials of what scientist who spent years trying to find Pluto before he died in 1916?

ANSWER: Percival Lowell

TOSS-UP

12. GENERAL SCIENCE: Short Answer: Its "white" variety is made of serpentine and its "blue" variety of sodium iron silicate. Name this general group of fibrous minerals used as insulation that can cause cancer when inhaled.

ANSWER: asbestos

BONUS

12. GENERAL SCIENCE: Short Answer: Five times stronger than steel, its discovery earned Stephanie Kwolek a place in the National Inventors Hall of Fame and the everlasting gratitude of thousands of DuPont shareholders. Identify this polymer most commonly used in bullet-proof vests.

ANSWER: Kevlar

TOSS-UP

13. CHEMISTRY: Short Answer: When Ernest Rutherford tried alchemy in 1919, he didn't try to convert lead into gold. Instead, he converted nitrogen into what other gaseous element that is next to it in the periodic table?

ANSWER: oxygen

BONUS

13. CHEMISTRY: Short Answer: What chemical indicator turns red in the presence of a strong acid and yellow in the presence of a weaker acid?

ANSWER: methyl orange

TOSS-UP

14. PHYSICS: Multiple Choice: What letter of the Greek alphabet is generally used to denote frictional coefficient?

- W) phi
- X) mu
- Y) alpha
- Z) gamma

ANSWER: X) mu (μ)

BONUS

14. PHYSICS: Short Answer: He served as London's Chief Surveyor after its Great Fire, created the universal joint, and discovered the cell. Name this British scientist whose law says that $F = kx$, where k is the spring constant.

ANSWER: Robert Hooke

TOSS-UP

15. MATH: Short Answer: Formed by taking a conic section with a plane diagonally intersecting one of the cones, it is ideal for acoustics because sound reverberates at its foci. Name this conic section with general form $x^2/a^2 + y^2/b^2 = 1$.

ANSWER: ellipse

BONUS

15. MATH: Multiple Choice: In the standard equation for an ellipse, what conic section do you get if you change the plus sign in the addition to a minus sign?

- W) hyperbola
- X) spiral
- Y) parabola
- Z) circle

ANSWER: W) hyperbola

TOSS-UP

16. BIOLOGY: Short Answer: It is the three-letter stock symbol of the biotech firm Genentech. Give this acronym for the genetic substance whose double-helix shape was discovered by Watson and Crick.

ANSWER: DNA

BONUS

16. BIOLOGY: Multiple Choice: Barnacles attached to whales, seaweed growing on turtles, and birds nesting in trees are all examples of--what type of relationship in which one species gains benefits from another without affecting it?

- W) symbiosis
- X) parasitism
- Y) mutualism
- Z) commensalism

ANSWER: Z) commensalism

TOSS-UP

17. EARTH SCIENCE: Multiple Choice: What type of cloud consists of ice crystals, looks thin and wispy, and only appears at high altitudes?

- W) nimbus
- X) stratus
- Y) cirrus
- Z) cumulus

ANSWER: Y) cirrus

BONUS

17. EARTH SCIENCE: Multiple Choice: Name the gem, found most in Afghanistan, that when crushed yields the shade of blue called "ultramarine."

- W) ruby
- X) quartz
- Y) lapis lazuli
- Z) turquoise

ANSWER: Y) lapis lazuli

TOSS-UP

18. GENERAL SCIENCE: Short Answer: Named for a British mathematician, it involves judging between a human response to conversation and a computer's response to the same conversation. Identify this test that a computer is said to "pass" if a human judge can't tell the two responses apart.

ANSWER: Turing test

BONUS

18. GENERAL SCIENCE: Short Answer: It was constructed in the 1940's at the University of Pennsylvania. Give either the acronym or the full name of this machine that, in 1946, proved that high-speed digital computing could be done with vacuum tubes.

ANSWER: ENIAC or Electronic Numerical Integrator and Computer

TOSS-UP

19. CHEMISTRY: Multiple Choice: The drugs ephedrine [EFF-a-dreen], atropine [ATRA-peen], morphine, caffeine and nicotine are all examples of what type of nitrogen compound?

- W) ethers
- X) aldehydes
- Y) alkenes
- Z) alkaloids

ANSWER: Z) alkaloids

BONUS

19. CHEMISTRY: Short Answer: It contains one correction for the attractive forces between molecules of a gas and another correction for the size of each molecule. Name this equation that expands the $PV = nRT$ into $(P + n^2a/V^2)(V - nb) = nRT$.

ANSWER: Van der Waals equation

TOSS-UP

20. MATH: Multiple Choice: A container has 24 balls in it: 6 red, 8 blue and 10 yellow. If you grab one ball without looking, what are your chances, in lowest terms, of grabbing a yellow ball first and then a red one?

- W) 5/12
- X) 6/23
- Y) 5/46
- Z) 1/3

ANSWER: 5/46 ($10/24 \times 6/23$)

BONUS

20. MATH: Short Answer: Divide the polynomial $6x^5 + 27x^4 + 37x^3 + 83x^2 - 17x - 40$ by the quantity $(2x^2 + 9x + 5)$.

ANSWER: $3x^3 + 11x - 8$

TOSS-UP

21. CURRENT EVENTS: Short Answer: In February 2004, British researchers may have discovered the hull of what ship, used to travel the world in the 1830's by Charles Darwin?

ANSWER: *HMS Beagle*

BONUS

21. CURRENT EVENTS: Multiple Choice: In February 2004, what is said to be the world's oldest fossil was found, 400-million-year-old *Rhyniognatha Hirsti* [rye-nee-OG-na-tha HURST-ee]. What kind of creature was it?

- W) reptile
- X) fish
- Y) mammal
- Z) insect

ANSWER: Z) insect

TOSS-UP

22. MATH: Short Answer: Consider a particle traveling through space with a velocity of $3x^2 + 13x - 5$ inches per second. Calculate the particle's acceleration at time = 1 second.

ANSWER: 19 in./sec² ($6x + 13$)

BONUS

22. MATH: Short Answer: Given the same equation, calculate the distance the particle travels between time = 0 and time = 1 second.

ANSWER: 2.5 (or 5/2) inches (integrate between 1 and 0)

TOSS-UP

23. BIOLOGY: Multiple Choice: The line named for British naturalist Alfred Wallace separates the animal species of what two continents?

- W) Asia and Australia
- X) Europe and Africa
- Y) North America and South America
- Z) Australia and Antarctica

ANSWER: W) Asia and Australia

BONUS

23. BIOLOGY: Multiple Choice: The DNA nitrogen base thymine [THIGH-meen] always pairs up with:

- W) guanine [GWAH-neen]
- X) cytosine [SY-ta-seen]
- Y) thymine [THY-meen]
- Z) adenine [AD-a-neen]

ANSWER: Z) adenine

TOSS-UP

24. PHYSICS: Short Answer: You stand at your bedroom window and drop a 4-kilogram basketball a distance of 3.5 meters to your friend on the ground. Assuming that gravity is 9.8 meters per second squared, how much potential energy, in joules, must your friend absorb to catch the ball without dropping it?

ANSWER: 137.2 J ($4 \times 3.5 \times 9.8$)

BONUS

24. PHYSICS: Short Answer: If the frequency of electromagnetic radiation is too low, the radiation cannot knock off loose electrons from metal no matter how intense the radiation is. Give the two-word term for this concept that won Albert Einstein his Nobel Prize.

ANSWER: photoelectric effect

TOSS-UP

25. CHEMISTRY: Multiple Choice: What British scientist is credited with the idea that the pressure of a gas mixture is equal to the sum of their partial pressures?

- W) Joseph Priestley
- X) Michael Faraday
- Y) John Dalton
- Z) Humphrey Davy

ANSWER: Y) John Dalton

BONUS

25. CHEMISTRY: Short Answer: Nowadays, it contains antimony and copper because they are known to be safer for people than lead is. Name this chemical alloy that is still more than 90% tin, just as it was in the days of the Revolutionary War.

ANSWER: pewter

END OF ROUND 3

TOSS-UP

1. ASTRONOMY: Short Answer: Though its second was launched before its first, they both celebrated their 25th anniversary during 2002. What pair of space probes visited Jupiter, Saturn, Neptune and Uranus between them?

ANSWER: Voyager

BONUS

1. ASTRONOMY: Short Answer: What constellation contains the star Albireo at its beak, the star Deneb at its tail, and three other stars that form its wingspan?

ANSWER: Cygnus (or the swan)

TOSS-UP

2. BIOLOGY: Short Answer: His most famous discovery came in 1898, and he won the Nobel Prize 8 years later. Name this Italian biologist whose name is used to describe the part of a cell that receives proteins for packaging from the endoplasmic reticulum.

ANSWER: Camillo Golgi (Golgi bodies)

BONUS

2. BIOLOGY: Multiple Choice: Medical-school students know that Camillo Golgi also discovered Type I and Type II of what kind of cells found in the human body?

- W) epithelial cells [ep-a-THEE-lee-ul]
- X) neurons
- Y) ganglions [GANG-lee-onz]
- Z) squamous cells

ANSWER: X) neurons

TOSS-UP

3. MATH: Multiple Choice: When the equation $r^2 = a^2 \sin 2\theta$ is graphed, the resulting curve, known as a "lemniscate", is shaped like:

- W) a cylinder
- X) a figure 8
- Y) a spiral
- Z) a hyperbola

ANSWER: **X) a figure 8**

BONUS

3. MATH: Short Answer: Calculate the value of dy/dx if $y = 5u^2 + 6$ and $u = 3x - 5$.

ANSWER: $dy/dx = \underline{90x - 150}$ (by chain rule) (prompt on "30u")

TOSS-UP

4. PHYSICS: Multiple Choice: What type of electronic filter would best be used to select a frequency range of 20-50 kHz out of a larger range of 1-100 kHz?

- W) notch filter
- X) bandpass filter
- Y) low-pass filter
- Z) high-pass filter

ANSWER: **X) bandpass filter**

BONUS

4. PHYSICS: Short Answer: Time begins on the left and ends on the right, a wavy line is a photon, and an arrow to the right is an electron in what type of diagram, named for a former Caltech physicist?

ANSWER: **Feynman** [FINE-munn] **diagram**

TOSS-UP

5. GENERAL SCIENCE: Short Answer: As an ambulance gets closer to you, the tone of its siren gets higher. As it goes away from you, the tone gets lower. This is one example of--what effect named for an Austrian physicist?

ANSWER: Doppler effect

BONUS

5. GENERAL SCIENCE: Short Answer: In astronomy, the Doppler effect says that radiation will shift what color when its wavelength increases?

ANSWER: redshift

TOSS-UP

6. CHEMISTRY: Short Answer: If the ideal gas equation is written in the form $PV = nkT$, n is the number of moles and k is what constant?

ANSWER: Boltzmann's constant

BONUS

6. CHEMISTRY: Short Answer: His classic text *Principles of Chemistry* was succeeded in 1871 by his draft of the periodic table that left spaces for elements not yet discovered. Name this pioneering Russian scientist.

ANSWER: Dmitri Mendeleev [men-da-LAY-yev]

TOSS-UP

7. EARTH SCIENCE: Short Answer: In 1863, chemists discovered there are actually two kinds of it: the one from Myanmar (which has the name everyone knows) and the one from China, called nephrite. Name this type of precious stone whose "imperial" variety is emerald green.

ANSWER: jade

BONUS

7. EARTH SCIENCE: Multiple Choice: Psychrometers [sigh-CRAW-ma-turz] and hygrometers [hi-GRAW-ma-turz] both measure:

- W) electron voltage
- X) wind speed
- Y) capacitance
- Z) humidity

ANSWER: Z) humidity

TOSS-UP

8. MATH: Multiple Choice: The surface area (in square inches) of a rectangular prism 2 inches by 5 inches by 9 inches is equal to:

- W) 73
- X) 90
- Y) 146
- Z) 292

ANSWER: Y) 146 ($2 \times [10 + 18 + 45]$)

BONUS

8. MATH: Short Answer: A pair of variables x and y are related by the equation $y = kx + z$. Calculate z when k is 1, x is 9 and y is 24.

ANSWER: 15

TOSS-UP

9. BIOLOGY: Short Answer: The opossum is the only North American variety of what type of mammal that includes Australian animals like wombats and kangaroos and keeps their young in pouches?

ANSWER: marsupials

BONUS

9. BIOLOGY: Short Answer: "Small" ones include sheep, goats, llamas and deer, while "large" ones include giraffes, camels and cows. Name this class of animals that chews their cud and has multiple stomach chambers.

ANSWER: ruminants

TOSS-UP

10. CURRENT EVENTS: Multiple Choice: According to the website of *Scientific American* in 2004, four different crops combine to produce more than half of the world's energy that comes from eating food. Which of these crops is NOT one of the four?

- W) wheat
- X) beans
- Y) potatoes
- Z) rice

ANSWER: X) beans (the 4th crop is corn or maize)

BONUS

10. CURRENT EVENTS: Multiple Choice: In March 2004, French scientists announced the success of a drug called "rimonabant" [ra-MON-a-bont] that promises to help fight the two most common causes of preventable death in America, which are:

- W) tobacco and alcohol
- X) alcohol and overeating
- Y) alcohol and car accidents
- Z) tobacco and overeating

ANSWER: Z) tobacco and overeating

TOSS-UP

11. ASTRONOMY: Multiple Choice: The recent book *For Spacious Skies* was written by Scott Carpenter, who became the second American to orbit the earth after he served as the backup for what man who was the first?

- W) Alan Shepherd
- X) Virgil Grissom
- Y) John Glenn
- Z) Buzz Aldrin

ANSWER: Y) John Glenn

BONUS

11. ASTRONOMY: Short Answer: On a white, perfectly reflective surface, its value is 1; on a black, perfectly absorbing surface, the value would be zero. Give this term that measures the intrinsic brightness of an astronomical object.

ANSWER: albedo

TOSS-UP

12. GENERAL SCIENCE: Short Answer: In a 1903 article for *Popular Mechanics*, he wrote about his work with both X-rays and radioactive elements. Name this inventor more famous for creating the phonograph and the light bulb.

ANSWER: Thomas Edison

BONUS

12. GENERAL SCIENCE: Short Answer: It could only go 84 miles per hour but carried more than 1,000 passengers across the Atlantic before it blew up in New Jersey in 1937. Name this ill-fated zeppelin.

ANSWER: Hindenburg

TOSS-UP

13. CHEMISTRY: Short Answer: The hydroxides of metals like lead, tin and zinc can all be described by this term, as can plain ordinary water. What chemical term describes substances that, depending on what they're mixed with, can react as either an acid or a base?

ANSWER: amphoteric

BONUS

13. CHEMISTRY: Short Answer: Folk remedies for it include orange juice and mouthwash. One more recent (and chemically logical) solution combines liquid soap, hydrogen peroxide and baking soda. Name this problem that has turned many suffering animals pink after their owners tried to solve it with tomato juice.

ANSWER: getting sprayed by a skunk

TOSS-UP

14. PHYSICS: Multiple Choice: When a neutron undergoes beta decay, it splits into three different particles. Which of the following is NOT one of those particles?

- W) proton
- X) electron
- Y) meson [MAY-zonn]
- Z) antineutrino

ANSWER: Y) meson

BONUS

14. PHYSICS: Short Answer: When a charged particle travels through a medium at greater than the speed of light for that medium, it emits a bluish light that is named for what Russian physicist?

ANSWER: Cherenkov radiation or effect

TOSS-UP

15. MATH: Multiple Choice: Many companies now use a "six sigma" system to reduce the variation of the products they output. If a company succeeds in implementing the system, what is the maximum number of defective parts they would make in any group of one million parts?

- W) 1
- X) 3
- Y) 5
- Z) 12

ANSWER: X) 3 (actually, it's 3.4, but 3 on a whole-number basis)

BONUS

15. MATH: Multiple Choice: Set A is "leap years between 1941 and 1983", set B is "numbers that end in 4 between 1,900 and 2,100" and set C is "multiples of 10 between 1,800 and 2,200." Find the union of sets B and C, and then tell which of the following numbers is NOT in the intersection of that union with set A:

- W) 1944
- X) 1960
- Y) 1968
- Z) 1980

ANSWER: Y) 1968

TOSS-UP

16. BIOLOGY: Short Answer: It kills hard-shelled animals by injecting poison from its salivary glands. Name this mollusk that escapes enemies by ejecting clouds of ink and has a ring of 8 tentacles around its mouth.

ANSWER: octopus

BONUS

16. BIOLOGY: Short Answer: His most famous theory was disproved by Charles Darwin. Name this French naturalist who thought that any characteristics acquired during an organism's lifetime would be passed on to its offspring.

ANSWER: Jean Chevalier de Lamarck

TOSS-UP

17. EARTH SCIENCE: Short Answer: What word, directly translated from the Greek, describes a mineral deposit that precipitates from a fluid whose main ingredient is hot water?

ANSWER: hydrothermal

BONUS

17. EARTH SCIENCE: Multiple Choice: In the United States, a red one is called a "ruby", but the term applies to all other colors of corundum or aluminum oxide. What gem's most expensive varieties are bright blue and come from India?

- W) amethyst
- X) garnet
- Y) sapphire
- Z) emerald

ANSWER: Y) sapphire

TOSS-UP

18. GENERAL SCIENCE: Multiple Choice: In engineering, which of these terms describes a working model that is built to evaluate an idea before a final product is officially manufactured?

- W) unofficial
- X) iteration
- Y) peripheral
- Z) prototype

ANSWER: Z) prototype

BONUS

18. GENERAL SCIENCE: Short Answer: In astronomy, it describes anything that is a gas at room temperature. What adjective that can also mean "highly explosive" can describe someone's highly-strung temperament where they may explode at any moment?

ANSWER: volatile

TOSS-UP

19. CHEMISTRY: Short Answer: Cooling it to 300 degrees below zero and putting 25 million pounds of pressure on it per square inch changes it from a diatomic gas into a solid. Name this chemical element that makes up nearly 80% of the earth's atmosphere.

ANSWER: nitrogen

BONUS

19. CHEMISTRY: Short Answer: Found naturally in compounds like ilmenite [ILL-ma-night] and rutile [ROO-tile], its dioxide form is the world's most popular chemical for making things white. Name this strong and lightweight metallic element also used in aircraft parts and space capsules.

ANSWER: titanium

TOSS-UP

20. MATH: Multiple Choice: The well-known numbers e and pi fit into what category of numbers that cannot be expressed as a fraction with any two integers?

- W) irrational numbers
- X) real numbers
- Y) complex numbers
- Z) counting numbers

ANSWER: W) irrational numbers

BONUS

20. MATH: Multiple Choice: The numbers e and pi also fit into what category of numbers that are not roots of any polynomial equation with integer coefficients?

- W) imaginary numbers
- X) whole numbers
- Y) transcendental numbers
- Z) infinitesimal numbers

ANSWER: Y) transcendental numbers

TOSS-UP

21. CURRENT EVENTS: Multiple Choice: In the summer of 2003, what planet got within 35 million miles of the earth?

- W) Mars
- X) Venus
- Y) Jupiter
- Z) Mercury

ANSWER: W) Mars

BONUS

21. CURRENT EVENTS: Short Answer: In 2004, the World Health Organization stated that more than 300,000 people every year catch a strain of it that is resistant to more than one drug. Identify this disease whose sufferers were once sent to a sanatorium.

ANSWER: tuberculosis or TB

TOSS-UP

22. BIOLOGY: Short Answer: Its Group B is now the main cause of life-threatening infections in newborn babies. Group A can cause rheumatic fever and also contains the so-called "flesh-eating bacteria". Identify this genus of bacteria that most commonly causes a very sore throat.

ANSWER: streptococcus

BONUS

22. BIOLOGY: Short Answer: It is used by nurses to check the breathing, pulse, muscle tone, skin color and reflexes of newborn babies. Identify this 10-point scale named for its founder.

ANSWER: (Virginia) Apgar scale

TOSS-UP

23. MATH: Multiple Choice: A village of 50,000 people is attacked by bubonic plague that kills 10% of the village every day. How many people will be left in the village after 3 days, when medication finally arrives?

- W) 45,000
- X) 40,500
- Y) 36,450
- Z) 35,000

ANSWER: Y) 36,450 (45,000, then 40,500, then 36,450)

BONUS

23. MATH: Multiple Choice: Calculate the determinant of the two-by-two matrix with a top row of 7 and 5 and a bottom row of 8 and 6.

- W) 26
- X) 15
- Y) 2
- Z) -7

ANSWER: Y) 2 (42 – 40)

TOSS-UP

24. CHEMISTRY: Short Answer: What term describes a substance that speeds up a chemical reaction without being changed itself?

ANSWER: catalyst

BONUS

24. CHEMISTRY: Short Answer: An aerosol is one type of it that involve gases, while a gel is another type that involves liquid. What is this substance made up of small particles evenly dispersed within another material that is in the intermediate state between a suspension and a solution?

ANSWER: colloid

TOSS-UP

25. PHYSICS: Short Answer: For the first time in 60 years, the University of California may not be managing it when its current contract runs out. What New Mexico laboratory was built during World War II to develop the atomic bomb?

ANSWER: Los Alamos National Laboratory

BONUS

25. PHYSICS: Multiple Choice: It is the average of an object's elements of mass, factored by their distances from a reference. Name this quantity, often found using a plumb bob, that describes an object's response to external forces and torques.

- W) center of gravity
- X) specific density
- Y) moment of inertia
- Z) potential energy

ANSWER: W) center of gravity

END OF ROUND 4

TOSS-UP

1. ASTRONOMY: Multiple Choice: At one point during 2002, which one of the following planets could NOT be seen very close to each other in the western sky?

- W) Mars
- X) Saturn
- Y) Mercury
- Z) Jupiter

ANSWER: **X) Saturn**

BONUS

1. ASTRONOMY: Multiple Choice: Stardust, CONTOUR and Deep Impact are among the recent spacecraft launched by NASA to study:

- W) comets
- X) meteors
- Y) asteroids
- Z) the Sun

ANSWER: **W) comets**

TOSS-UP

2. BIOLOGY: Short Answer: Removing nitric oxide from the body may cure this disease caused by pressure on the optic nerve. What disorder can be diagnosed by your ophthalmologist after blowing a puff of air into your eye?

ANSWER: **glaucoma**

BONUS

2. BIOLOGY: Short Answer: What general part of your body contains the zygomatic [zigh-ga-MAT-ick] bone?

ANSWER: **face or head**

TOSS-UP

3. MATH: Multiple Choice: What is the relationship between the complex numbers $(3 - 6i)$ and $(3 + 6i)$?

- W) additive inverses
- X) multiplicative inverses
- Y) opposites
- Z) conjugate pair

ANSWER: **Z) conjugate pair**

BONUS

3. MATH: Short Answer: His Conjecture in three-dimensional topology went unproven for nearly 100 years until Russian math professor Grigori Perelman announced he had proved it in 2003. Name this 20th-century French mathematician.

ANSWER: Henri **Poincaré** [pwahn-ca-RAY]

TOSS-UP

4. PHYSICS: Short Answer: What scientific principle states that the exact momentum and exact location of a particle can never be known at the same time?

ANSWER: **Heisenberg's Uncertainty** Principle

BONUS

4. PHYSICS: Multiple Choice: According to Heisenberg's Uncertainty Principle, the measurement error is always at least equal to what value?

- W) Hubble's constant
- X) Permittivity of free space
- Y) Rydberg constant
- Z) Planck's constant

ANSWER: **Z) Planck's constant**

TOSS-UP

5. GENERAL SCIENCE: Multiple Choice: What computer software included in the Microsoft Office package is called a "presentation graphics" program and often used to make overhead slides?

- W) Access
- X) PowerPoint
- Y) Project
- Z) Excel

ANSWER: **X) PowerPoint**

BONUS

5. GENERAL SCIENCE: Short Answer: This form of lily grows up to 40 feet tall--but only in California's Mojave [mo-HAH-vee] Desert. Identify this plant whose raised arms gave it the name of an Old Testament prophet.

ANSWER: **Joshua tree**

TOSS-UP

6. CHEMISTRY: Short Answer: Give the valence of chromium in the compound "chromic oxide", Cr_2O_3 .

ANSWER: **+3**

BONUS

6. CHEMISTRY: Short Answer: Give the valence of chromium in the compound "potassium dichromate", $\text{K}_2\text{Cr}_2\text{O}_7$.

ANSWER: **+6**

TOSS-UP

7. EARTH SCIENCE: Multiple Choice: The mineral called "malachite" [MAL-a-kite] is green because it contains what metallic element?

- W) zinc
- X) vanadium
- Y) iron
- Z) copper

ANSWER: Z) copper

BONUS

7. EARTH SCIENCE: Short Answer: They are caused by the interaction between the Earth's magnetic field and the stream of particles known as the "solar wind." Identify these two belts of ionized gas that circle the Earth and are named for an American physicist.

ANSWER: Van Allen belts

TOSS-UP

8. MATH: Short Answer: If the function $f(x) = x^4 - 6x^3 - 4x^2 + 8x - 6$, calculate the value of $f(x)$ at $x = 2$.

ANSWER: -38

BONUS

8. MATH: Multiple Choice: The volume in cubic inches of a right circular cylinder with radius and height both 10 inches is equal to:

- W) 100 pi
- X) 500 pi
- Y) 1000 pi
- Z) 2000 pi

ANSWER: Y) 1000 pi

TOSS-UP

9. BIOLOGY: Multiple Choice: Which of these sea creatures are contained in the phylum *Porifera* [pa-RIFF-a-ra]?

- W) sea cucumbers
- X) sponges
- Y) sea horse
- Z) sharks

ANSWER: X) sponges

BONUS

9. BIOLOGY: Short Answer: Give the term for the biological process that begins when a chemical makes algae grow so thickly in a river that sunlight is blocked from reaching the plants underneath the algae and ends when the plants die and can't be used as food for the fish.

ANSWER: eutrophication

TOSS-UP

10. CURRENT EVENTS: Short Answer: In 2004, the nations of Nigeria, India, Pakistan, Egypt, Afghanistan and Niger all signed an agreement to finish vaccinating their children against what disease whose first vaccine is credited to Dr. Jonas Salk?

ANSWER: poliomyelitis

BONUS

10. CURRENT EVENTS: Short Answer: Name the California lab whose founder Victor Conte was recently indicted on charges of illegal distribution of steroids, some of which may have gone to prominent athletes.

ANSWER: BALCO or Bay Area Laboratory Cooperative

TOSS-UP

11. ASTRONOMY: Multiple Choice: On what 1969 space mission did Neil Armstrong and Buzz Aldrin walk on the moon?

- W) Apollo 9
- X) Apollo 11
- Y) Apollo 12
- Z) Apollo 13

ANSWER: **X) Apollo 11**

BONUS

11. ASTRONOMY: Multiple Choice: In what U.S. state would you find the Keck Observatory?

- W) Hawaii
- X) California
- Y) Massachusetts
- Z) New Hampshire

ANSWER: **W) Hawaii**

TOSS-UP

12. GENERAL SCIENCE: Short Answer: In 2001, the British government announced plans to re-route traffic around it and move its visitors center two miles away. What landmark of southern England features a set of ancient rocks thought to have been used as a giant calendar?

ANSWER: **Stonehenge**

BONUS

12. GENERAL SCIENCE: Short Answer: Scientists once thought it was the part of a combustible substance that was released by burning it. What substance was finally proved nonexistent by French chemist Antoine Lavoisier [la-vwah-zee-AIR]?

ANSWER: **phlogiston** [fla-JIS-tun]

TOSS-UP

13. CHEMISTRY: Short Answer: It is found in the compound dolomite [DOUGH-la-mite], and its hydroxide can serve as an antacid. Name this flammable metal whose hydrous sulfate form is often called "Epsom salts."

ANSWER: magnesium

BONUS

13. CHEMISTRY: Short Answer: Named from the Greek for "bearer of light", it was discovered in the mid-1600s while looking for the famed Philosopher's Stone. What chemical element has a name in Spanish that sounds very much like the Spanish word for "matches"?

ANSWER: phosphorus ("fósforos")

TOSS-UP

14. PHYSICS: Short Answer: An electrical transformer's primary winding has 100 turns and puts out 20 volts. Give the voltage on the secondary winding if it contains 800 turns.

ANSWER: 160 volts

BONUS

14. PHYSICS: Multiple Choice: For this same transformer, 1 ampere of current runs through the primary winding while generating the 20 volts. How much resistance is on the secondary winding?

- W) 20 ohms
- X) 160 ohms
- Y) 640 ohms
- Z) 1280 ohms

ANSWER: Z) 1280 ohms [160 V / 1/8 A]

TOSS-UP

15. MATH: Short Answer: Matrix A has a top row of 6 and 9 and a bottom row of -4 and -5. Matrix B has a top row of 3 and 2 and a bottom row of -3 and 1. Give the value of the top left element in the product $A \times B$.

ANSWER: -9

BONUS

15. MATH: Short Answer: If you're riding your bicycle at 10 miles per hour, how fast are you going in "furlongs per fortnight"? Note that 8 furlongs equal 1 mile and a fortnight equals 14 days.

ANSWER: 26,880 furlongs per fortnight ($10 \times 8 \times 24 \times 14$)

TOSS-UP

16. BIOLOGY: Short Answer: It won Swiss entomologist Paul Mueller the 1939 Nobel Prize in Medicine for its discovery. Though still used to treat mosquitoes, it was banned in Canada and the U.S. in the 1970s partly because it thins the shells of bird eggs. Give the three-letter abbreviation for this insecticide.

ANSWER: DDT

BONUS

16. BIOLOGY: Short Answer: Taro root, yams and cassava [ka-SAW-va] all fit into what class of starchy edible plant that also includes truffles and potatoes?

ANSWER: tubers

TOSS-UP

17. EARTH SCIENCE: Short Answer: What is measured in Roman numerals on the Mercalli scale and in decimals to the nearest tenth on the Richter scale?

ANSWER: earthquake intensity

BONUS

17. EARTH SCIENCE: Short Answer: Pleistocene [PLY-sta-seen], Miocene [MY-a-seen], and Holocene [HO-la-seen] are all names to describe--what unit of geologic time that is shorter than a period?

ANSWER: epoch

TOSS-UP

18. GENERAL SCIENCE: Short Answer: One example of it in geology is that younger rock is found on top of older rock. Name this principle used in physics to mean that the total effect of two voltage sources on an electric circuit is equal to the sum of the individual effects of the two sources.

ANSWER: superposition

BONUS

18. GENERAL SCIENCE: Short Answer: Between 1811 and 1816, he led groups of workers to destroy the large machinery that was putting thousands of them out of work. Identify this Englishman whose name is still used today to describe people who have a fear or hatred of new technology.

ANSWER: Ned Ludd (accept Luddites)

TOSS-UP

19. CHEMISTRY: Multiple Choice: The Bronsted-Lowry theory divides compounds based on whether they donate or accept:

- W) neutrons
- X) electrons
- Y) quarks
- Z) protons

ANSWER: Z) protons

BONUS

19. CHEMISTRY: Short Answer: Its pure, or "glacial", form solidifies at about 62° Fahrenheit. When diluted, it is sold in supermarkets as "vinegar." Name this sour-tasting acid with formula CH_3COOH .

ANSWER: acetic acid (or ethanoic acid)

TOSS-UP

20. MATH: Short Answer: Let $z = x^2y^2 + 2x^2y + 2xy^2 + 3x + 4y - 6$. Calculate the partial derivative of z with respect to x .

ANSWER: $2xy^2 + 4xy + 2y^2 + 3$

BONUS

20. MATH: Short Answer: Given the same equation for z , calculate the second partial derivative of z with respect to y .

ANSWER: $2x^2 + 4x$

TOSS-UP

21. CURRENT EVENTS: Short Answer: Trim Spa, Ripped Fuel, Speed Stack, Thermadrine and Xenadrine [ZEN-a-dreen] are all nutritional supplements that contain what substance banned by the FDA in 2003?

ANSWER: ephedra or ma huang

BONUS

21. CURRENT EVENTS: Multiple Choice: What type of animal did scientists clone at Texas A&M in December 2003 and name Dewey?

- W) a sheep
- X) a deer
- Y) a pig
- Z) a pelican

ANSWER: X) a deer

TOSS-UP

22. MATH: Short Answer: In any given mathematical region, what is the minimum number of colors needed to make sure that sub-regions with the same color don't touch each other?

ANSWER: 4

BONUS

22. MATH: Multiple Choice: What Greek letter is assigned to the irrational number approximately equal to 1.618, sometimes called the "golden ratio" ?

- W) phi
- X) omega
- Y) gamma
- Z) sigma

ANSWER: W) phi

TOSS-UP

23. BIOLOGY: Multiple Choice: What scientist is credited as the first to observe protozoa, red blood cells, and bacteria?

- W) Galileo Galilei
- X) William Jenner
- Y) Anton van Leeuwenhoek [LAY-vun-hoak]
- Z) Luigi Galvani

ANSWER: **Y) Anton van Leeuwenhoek**

BONUS

23. BIOLOGY: Short Answer: It metabolizes carbohydrate, and synthesizes proteins and lipids. Name this cell transport system whose rough type contains ribosomes and whose smooth type does not.

ANSWER: **endoplasmic reticulum** (or **E.R.**)

TOSS-UP

24. PHYSICS: Multiple Choice: Each of the 6 "flavors" of quarks has three possible "colors." Which of the following is NOT one of those three colors?

- W) yellow
- X) red
- Y) blue
- Z) green

ANSWER: **W) yellow**

BONUS

24. PHYSICS: Short Answer: The specific heat of aluminum is 0.9 joules per gram degree Celsius. How much heat in joules must be added to a 1.4-kilogram mass of aluminum to increase its temperature from 10 degrees Celsius to 40 degrees Celsius?

ANSWER: **37,800 J** or **37.8 kJ** ($0.9 \times 1400 \times 30$)

TOSS-UP

25. CHEMISTRY: Multiple Choice: What capital letter usually represents the equilibrium constant?

- W) E
- X) K
- Y) R
- Z) V

ANSWER: X) K

BONUS

25. CHEMISTRY: Short Answer: What adjective describes alcohol that has had material added so it is unfit for drink and therefore safe for use in chemistry lab experiments?

ANSWER: denatured alcohol

END OF ROUND 5